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ABSTRACT

A nonlinear approach to phonology that is more constrained than linear theory is proposed. The theory disallows rules of feature changing, resulting in a stronger, more consistent, and more interesting theory. Specifically, it is suggested, and tested with data from Chukchi, that dissimilations and other nonassimilatory rules are rules of feature deletion, and that use of the nonlinear approach allows the formal theory of rules to be more tightly constrained. (MSE)

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Dissimilation as Deletion in Chukchi

by

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DISSIMILATION AS DELETION IN CHUKCHI

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Two general arguments can be made for a nonlinear theory of phonology over a linear theory. The first emphasizes that the linear theory lacks the power to express correct generalisations regarding dissynchrony between features, for example that it cannot handle floating tones, contour tones, or tone stability. The second is that the linear theory is too powerful, since it allows excess latitude in its characterisation of a possible phonological rule. I concentrate here on the excess power argument, and raise the question whether we can adopt a nonlinear theory which is more constrained than the linear theory, namely a theory which disallows rules of feature changing. Such a theory is more restrictive, hence more interesting, than a theory which is simply the union of the linear and the nonlinear theories.

The general conception of a phonological rule in the linear theory is simply that by a rule, a segment is assigned arbitrary feature values in an arbitrary environment. A rule of the form (1) is well-formed in the linear theory, where W, X, Y and Z are arbitrary features and α, β, γ and δ are arbitrary values.

(1) $[\alpha W] \rightarrow [\beta X, \gamma Y] \; / \; ____ \; [\delta Z]$

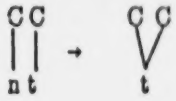
There is no reason to expect any specific relations to hold between the feature coefficients or the feature values.

The nonlinear theory offers a different conception of rules, which modify the temporal domain of features. Assimilation of L tone to Falling tone after H is expressed by expanding the domain of H to the right.

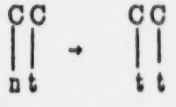
(2)

Work in the nonlinear framework has demonstrated the superiority of this view of assimilation over the feature changing types of rules employed in the linear theory. There are two arguments for the nonlinear spreading theory, one based on insights of the theory, and the second being an argument directed against the linear alternative. The first type of argument is given in Hayes (1986). Rules of assimilation when expressed as spreading will yield an output which is distinct from its input, whereas the output of feature-changing assimilation is not geometrically distinguishable from its input.

(3) a. *Spreading*

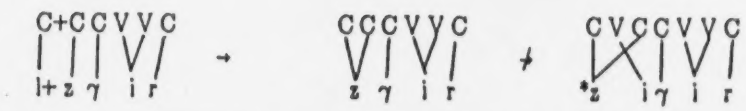


b. *Changing*



Tests which distinguish between these representations provide evidence that supports spreading over feature changing. One argument is the interaction between assimilation and the principle of integrity. It has been noticed that geminate segments exhibit unexpected resistance to rules of epenthesis. For example, in Palestinian Arabic, *i* is inserted to break up consonant clusters in certain positions. Insertion is prohibited if the two consonants are identical, as in the two *t*'s of *sitt*, which does not become **sitit*. Given that geminates are single segments linked to multiple C slots, epenthesis into geminate clusters is blocked by the ban on crossing association lines. Assimilated segments always exhibit the same behavior. In Palestinian, the definite article *l* seen in (4b) assimilates to a following coronal, and the resulting geminate consonants cannot be split, as predicted by the principle of Integrity.

(4) a.

b. 

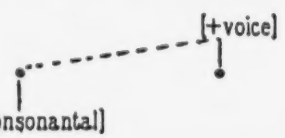
A similar argument is available based on the property of inalterability, which is the failure of the halves of geminates to independently undergo phonological rules. These two arguments converge at the conclusion that assimilations yield structures like (3a), which supports the theory of assimilation as spreading. What makes us want to adopt spreading as the general theory is not just that *some* assimilation rules result in inalterability and integrity, but that *all* assimilation does. This consistency requires an explanation, and the most obvious explanation is that the sole mechanism available for assimilation is spreading.

Now we turn to arguments directed specifically against the linear theory. One problem with assimilation as feature changing is that it does not provide any distinction between natural assimilations like (5a) and arbitrary feature changing rules like (5b).

(5) a. [+consonantal] → [+voice] / ____ [+voice]

b. [+consonantal] → [+voice] / ____ [+continuant]

A very good reason for distinguishing between these two rules is that the former rule is natural, whereas the latter is nonexistent. The theory of assimilation as spreading does distinguish between these rules. Rule (5a) can be translated into the nonlinear rule (6a) since it involves spreading of feature and feature value, but no such translation is possible for (5b).

(6) a. 

Laryngeal tier

Root node

Stricture tier

There is no straightforward explanation for this difference in rule naturalness in the linear theory.

Given the strong motivation to adopt the spreading theory of assimilation, that theory must replace the linear account of assimilation and not just be an addition to it. Simply adding the mechanism of spreading to the theory without also disallowing the feature changing alternative achieves little. The problem with disallowing the feature changing version of assimilation on principled grounds is very simple: there is no formal distinction between assimilation and other arbitrary rules in the linear theory, hence there is no obvious way to address the class of assimilations. I suggest that there is no need to seek typological principles distinguishing assimilations from all other rules: the problem lies not just with assimilation as feature changing, but with feature changing itself.

The added generative power of feature changing rules should not be underestimated. Consider only rules whose determinant is a single segmental matrix, whose position relative to the focus is irrelevant. Feature changing rules written with standard linear notation can be partitioned into two sets, rules which could be expressed as feature spreading (all features in the structural change are included in the determinant, and the value assigned to the feature in the structural change is identical to the value of the corresponding feature in the determinant), and those which cannot, the latter set being the set of necessarily feature changing rules. The number of theoretically possible rules falling in either set can be calculated, and is a function of the number of features assumed to be necessary in phonological theory. Given the assumption of 21 features, including the set of necessarily feature changing rules gives us access

to an additional 2.7 trillion trillion rules, rules which are impossible in a theory allowing no feature changing.[1] Simply prohibiting all feature changing results in a much stronger, more consistent, and more interesting theory.

Even if the most common type of rule is assimilation, other rules do exist. The question that arises in attempting to eliminate feature changing is how we are to handle the nonassimilatory residue. The answer to this question is not immediately obvious, since, although the recent phonological literature is filled with assimilatory rules, dissimilations are quite hard to find. My suggestion, to be tested against data from Chukchi, is that dissimilations and other nonssimilatory rules are simply rules of feature deletion. To reduce the inventory of processes even further, I will also treat deletion as a side-effect of feature delinking.[2] The output of such deletion rules is submitted to the rules of default feature specification and are also subject to structure-preserving rules of linking. I have selected Chukchi as an illustration of this approach since it has quite a number of dissimilations and assimilations, and thus offers us numerous opportunities to test the theory.

Certain assumptions will be necessitated by the deletion approach, assumptions which are independently motivated and which have analogs in the linear theory of markedness and linking. First I assume that default rules introduce unmarked feature values. Any of the rules in (7a) are legitimate default rules, whereas the rules in (7b) which introduce marked feature values cannot be default rules.

(7) a. [-sonorant] → [-voice] (*p,t,k* are less marked than *b,d,g*)

V
[+back,-low] → [+round] (*u,o* are less marked than *i,e*)

C
[+back] → [+high] (*k* is less marked than *q*)

b. [+sonorant] → [-voice] (sonorants are only rarely voiceless)

V
[+back,-low] → [-round] (almost no language has *i* without *u*)

C
[+back] → [+low] (pharyngeals are rare)

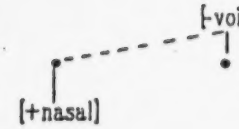
This entails that the results of dissimilations should be relatively less marked. For example, dissimilation could never yield a pharyngeal consonant as its output.

A second important part of the theory is the issue of rule side-effects which has been discussed elsewhere under the guise of linking. The problem is that one ideally wants the action specified by a rule to be highly restricted, perhaps only affecting a single feature or node, and allow concomitant changes to follow by structure preserving principles. A simple case of such a linking effect can be seen in the Denasalisation rule of Toba Batak discussed in Hayes (1986). Before voiceless consonants, nasal consonants are replaced with a homorganic voiceless stop (*mt* → *pt*, *ŋt* → *kt*). Without a theory of feature linking this would involve three feature changes, as in (8).

(8) [+nasal] → $\begin{bmatrix} \text{-voice} \\ \text{-nasal} \\ \text{-sonor} \end{bmatrix}$ / ____ [-voice]

A simpler analysis is possible if we state the rule as regressive devoicing as in (9), with loss of sonorant and nasal being the result of structure preservation effects, due to the lack of voiceless nasals or sonorants in this language.

(9)



Laryngeal tier

Root node

Nasal tier

I will not go into the question of predicting when a rule will exhibit this kind of structure-preserving effect, since that is an issue which is rather controversial and tangential to the central issue of this paper.

We may now move to Chukchi consonant alternations. The question we will be addressing is whether a coherent and internally consistent account of Chukchi is possible foregoing feature changing. Primary data on Chukchi are available from Skorik (1961) and Bogoras (1922); generative analyses of Chukchi phonology in a linear framework are available in Krause (1980) and Kenstowicz (1986). My data will be taken primarily from the latter two sources, with additional examples from Skorik (1961).[3] The Chukchi consonant inventory is that given in (10), arranged into the traditional manner and place of articulation scheme. The consonant system is rather atypical in having a lateral as its only voiceless fricative.

(10)						
	p	t	k	q	ʔ	*voiceless stop*
		č				*voiceless affricate*
		ɬ				*voiceless fricative*
	m	n	ŋ			*nasal*
		r				*voiced stop*
	(w)	y	ɣ (w)			*voiced continuant*

Some notes on the use of feature in Chukchi are in order. The glide *w* acts both like a labial and a velar, consistent with the fact that is is both high and back, and also labial. First, there is an old controversy over the status of nasals as stops or continuants, and I treat nasals as continuants. Second, the glide *y* and the [+coronal] consonants, involving raising of the tip of the tongue, act as a natural class for quite a number of rules. Coronals and *y* share the feature [-grave] so rules grouping coronals and *y* together will make reference to that feature, and there will be no need for rules to refer to the feature [coronal] in Chukchi.

Since the set of linking rules will play a role in the analysis, I start there. Some of these rules are universal tendencies, for example the fact that sonorants and nasals are voiced. Other facts, such as the fact that the voiced velar obstruent is a fricative and not a stop, are language specific facts. The list in (11) is by no means complete or optimal – it merely serves as a guide to some of the redundancies and interdependencies in the consonant system.

(11)			
	[+nasal]	→	[+voice,+continuant]
	[+sonorant]	→	[+voice]
	[+voice,+back]	→	[+continuant]
	[+lateral]	→	[-voice]
	[+back,+labial,+continuant]	→	[+sonorant]
	[+back,-labial,+continuant]	→	[-sonorant]
	[-sonorant,-continuant]	→	[-voice]
	[-grave,+cons]	→	[+coronal]

As will be evident throughout the analysis, adjacent consonants with identical features in the place of articulation set represent those shared features as one instance of the feature associated to two segments. A cluster such as *nɬ* will be given a representation like (12), having only one instance of the feature [grave] linked to two segments.

(12) [+nasal] [-nasal] *Nasal tier*

Root node

Place node

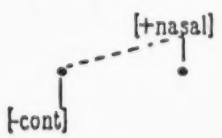
This is simply the OCP applied to individual place features. Two types of evidence will be found to support the collapsing of adjacent identical place features. First, numerous rules apply to sequences of consonants which have identical values for one or more place features, a generalisation which can be efficiently expressed by assuming representations such as (12). Second, we will see evidence of inalterability effects in the lenition rule, which requires place features to be shared between segments.

Now we may turn to phonological alternations, starting with some assimilations. The first rule nasalises stops before a nasal, illustrated in (13). Note that continuants like ɣ and ɬ are not nasalised.

(13)	*Nasalised*		*Non-nasalised*	
	ɣe-mne-ɬin	"he ground"	pənc-k	"grind"
	rəmn-ət	"flesh side of hides"	rəpən	"flesh side of hide"
	ɣa-mŋət-ɬen	"having news"	pəŋəɬ	"news"
	ɣa-nmə-ɬen	"he killed"	təm-ək	"kill"
	pɬek-ət	"footware"	te-pɬeŋ-ŋ-ək	"make footware"
	ɣa-tattəwaɬ-m		"with splinters of thigh"	
	ɣe-ɣnu-ɬin		"was superfluous"	
	eymew-ək		"he approached"	

The spreading rule (14) will handle these alternations.

(14) *Nasalisation*



Nasal tier

Root Node

Stricture Features

One case of structure preservation can be seen already. Nasals are automatically voiced, sonorant and continuant in this language, so the value of voicing and continuancy need not be explicitly included in (14). The output of (14) is automatically assigned [+voice, +cont, +son], by structure preserving principles.

A second rule assimilates ŋ to the place of articulation of the following consonant. The [-grave] consonant y shifts ŋ to n, and the labial w shifts ŋ to m. Only ŋ, and not m or n, will assimilate.

(15)	teŋ-əɬʔ-ən	"good"	tam-waɣərɣ-ən	"good life"
	tam-pera-k	"to look good"	tan-čotčot	"good pillow"
	tan-ɬəmŋəɬ	"good story"	tan-rʔarqə	"good breastband"
	ten-yəɬqet-ək	"to sleep well"		
	nə-mkə-kin	"often"	ɣa-n-pera-w-ɬen	"decorated"

Place assimilation for the velar nasal is accounted for by the spreading rule (16).

(16) *Place Assimilation*

By application of a lenition rule illustrated in (17), postvocalic *k* becomes *ɣ* before another consonant. This can be explained as assimilative spreading of [+continuant] from the vowel to *k*.

(17)	mək-atənwə̣-ən	"having many wounds"	məɣ-pətwə̣-ən	"many-storied"
	məɣ-yan	"greater part"	məɣ-čisḷo	"many numbered"
	məɣ-ḷiɣḷiɣ	"many eggs"	məɣ-miḷɣer-e	"many guns"
	məɣ-nennet	"many otter"		

Note in (18) that *k* does not lenite before another [+back] consonant. In line with this restriction, the last two examples in (17) show that *k* lenites before a nasal instead of nasalising, but (18) shows that *k* before *ŋ* nasalises instead of leniting.

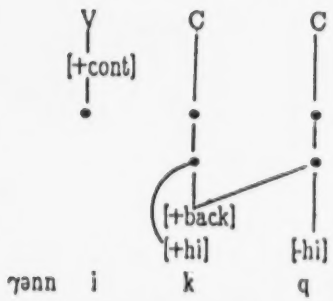
(18)	mək-ɣərɣ-ən	"multitude"	ekke-t	"sons"
	ʔaaček-qaat	"young buck"	ɣənnik-qey	"small animal"
	pḷek-ət	"footware"	te-pḷeŋ-ŋ-ək	"make footware"

The postvocalic lenition of (17) will be accounted for by (19).

(19) *Lenition*

The restriction that the following consonant cannot also be [+back] need not be independently stipulated. Given that identical place features in Chukchi are fused into one multi-linked feature, plus the Linking Constraint in Hayes (1986) which predicts inalterability phenomena, forms such as *ɣənnik-qey* cannot undergo Lenition.

(20)



CV tier
Stricture features
Root node
Place node

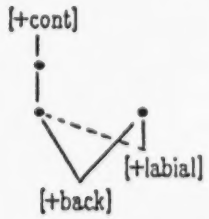
The Linking Constraint blocks Lenition in (20) since it interprets the link between [+back] and its place node in rule (19) as the only link to [back], whereas in (20) [+back] is linked to two segments.

The last assimilation to be considered is illustrated in (21); that rule labialises *ɣ* to *w* before or after *w*. The output of that rule is then submitted to Fricative Dissimilation, to be discussed later, yielding surface *kw*.[4]

(21)	meni*ɣ*	"cloth"
	wətəč*ɣ*-ən	"overalls"
	manek-wətəč*ɣ*-ən	"overalls cloth"
	təw-ək	"to tell"
	tək-wər*ɣ*-ən	"communication" [nominal suffix -*ɣərɣ*-]

W-labialisation (22) will handle this set of alternations.

(22) *W-Labialisation* (mirror image)



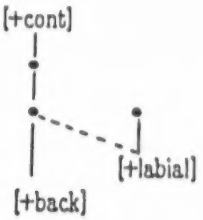
Stricture features
Root node
Place node

A second labialisation rule exists which labialises *ɣ* to *w* when it stands before any labial (not just *w*); hence *ɣm* and *ɣp* become *wm* and *wp*.

(23)	ətḷə*ɣ*-ən	"father"	ətḷəw-poy*ɣ*-ən	"father's spear"
	ʔi*ɣ*-ən	"wolf"	ʔiw-pipiq-əḷ*ɣ*-ən	"lemming"(wolf+mouse)
	n-etḷe*ɣ*-qin	"sweet"	etḷew-mətqəmət	"honey"

The change of *ɣ* to *w* does not take place after *m* or *p* (cf. *ɣa-pɣal-ḷen* "he has surfaced", *ɣəlam-ɣərɣ-ən* "accuracy"), so this process must be kept separate from the mirror image process seen in (21). Thus (24) is needed: that rule does not require [+back] to be shared by focus and determinant.

(24) *Obstruent-Labialisation*



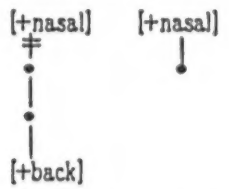
So far we have seen that the assimilatory rules of Chukchi can be handled without feature changing. The interesting question is how the nonassimilatory part of the grammar will be handled. Many nonassimilatory rules in Chukchi are truly dissimilatory, deleting a feature in the environment of an identical feature. Some cannot be characterised as dissimilations in this sense. To underscore the generality of the proposals made here, all nonassimilatory rules are treated in the same manner.

The first of the dissimilatory rules is one changing *ŋ* to *ɣ* before any nasal.

(25)	taraŋ-ək	"build a dwelling"	nə-taraɣ-more	"we built a dwelling"
	məṭḷəŋ-ən	"five"	məṭḷəɣ-more	"we five"
	enawrəŋ-ək	"to give as a gift"	enawrəɣ-nen	"he gave it"
	pet?iŋ	"cold"	pet?iɣ-ŋinqey	"boy with a cold"

The alternation involved here is an apparent change of [+nasal] to [-nasal], where assimilatory spreading is not at work. Stated as the deletion rule (26), these alternations simply involve loss of [+nasal] before [+nasal].

(26) *Denasalisation*



By application of the default rule for [nasal], the output of (26) is assigned the value [-nasal].

(27) enawrəŋ - nen → enawrəK - nen → enawrəɣ - nen

Denasalisation *Default*

+N +N +N -N +N

A second dissimilatory rule applies to a cluster of identical spirants, the first of which becomes a voiceless stop. Thus, *ll̥* becomes *tl̥*, *ɣɣ* becomes *kɣ*, and *ww* becomes *kw* (phonetically *k^{w}*).

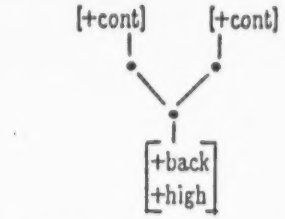
(28)	menlɣ	"cloth"	manek-ɣəpə	"from cloth"
	ətḷəɣ-ən	"father"	ətḷək-ɣəyiwq-ew	"paternal marking"
	rəɣrəɣ	"wool"	rəɣrək-ɣəpə	"from wool"
	yeɣteḷ-ək	"to live"	ɣe-yeɣtet-l̥in	"he lived"
	l̥əmŋəl̥teḷ-ək	"tell stories"	ɣa-l̥əmŋəl̥tet-l̥en	"told stories"
	ŋew-?en	"woman"	ŋak-waŋe-ɣərɣ-ən	"woman's sewing"
	il̥ɣətew-ək	"to wash"	il̥ɣətek-w?i	"he washed"

One important feature of this rule is that only homorganic clusters dissimilate. Other combinations, such as *yɣ*, *wl̥*, or *l̥ɣ* in (29) remain unchanged.

(29) kətəyɣat-ək "blow" ɣa-n-pera-w-l̥en "decorated"
ʔiw-pipiq-əl̥ɣ-ən "wolf mouse"

Given that identical place features are fused into one multi-attached feature, the dissimilation rule identifies geminate fricatives by sensitivity to the distinctive geometry of homorganic clusters. The input to *Geminate Fricative Dissimilation* in the case of ɣɣ would be a structure like (30).

(30)

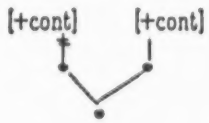


Stricture features
Root node
Place

m a n e ɣ + ɣ ə p ə

Rule (31) then accounts for these dissimilations.

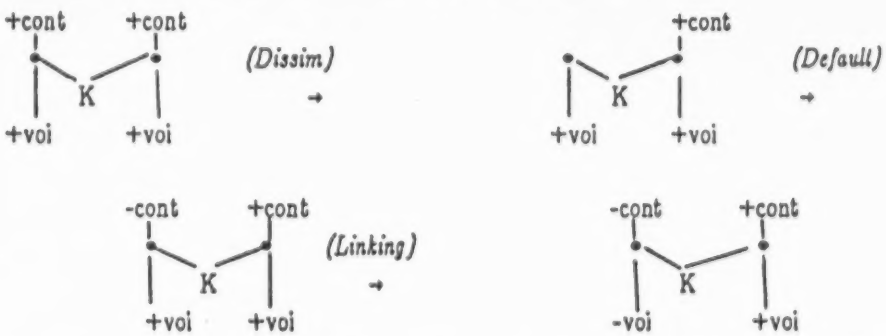
(31) *Geminate Fricative Dissimilation*



Stricture features
Root node
Place node

The default value [-continuant] is assigned to the output of this rule, and in the case of l̥l̥ from l̥l̥ we get the phonetic form directly. In the case of ww and ɣɣ, the output is further modified by a linking rule for voicing, which guarantees that all obstruent stops in Chukchi are voiceless, yielding a voiceless stop k. The derivation of kɣ from ɣɣ is given in (32): K abbreviates velar place of articulation.

(32)

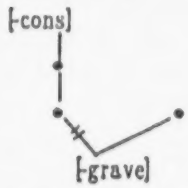


In (33) we see a third dissimilation which results from combining y with a following [-grave] consonant, in which case y dissimilates to ɣ.

(33)	w?ey-ək	"grass"	w?eɣ-ti	"grasses"
	ŋin-qey	"boy"	ŋen-qaɣ-čəŋ-ən	"big boy"
	čay	"tea"	čaɣ-nal̥k-ək	"to make tea"
	qey-we	"correct"	qeɣ-l̥ananɣet	"truth"
	qeyəqey	"nestling"	qaɣ-ya?yaq	"young seagull"

What happens here is that the glide y disassociates from the feature [grave] by (34), triggering the shift to velar by default and structure-preserving rules.

(34) *Y-dissimilation*



Stricture features

Root node

Place node

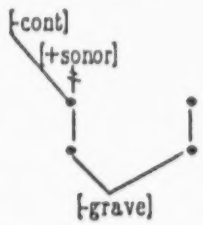
Only the default feature [+grave] needs to be supplied. The selection of the default value [+grave] where the segment in question is already [+high] is motivated by the unmarked status of velars relative to palatals. The shift of *y* to *w* as an alternative would require the additional specification of the marked value [+labial], counter to the hypothesis that dissimilations do not result in the addition of marked features. A further modification of the output of *Y-dissimilation* takes place after default place assignment, in the form of a linking rule which make the segment an obstruent, in line with the fact that the oral back nonlabial continuant of Chukchi is an obstruent.

Another non-assimilatory rule is found with *r* before any nongrave consonant (including *y*), where *r* becomes *t*, and then like basic *t* is subject to nasalisation before *n*.

(35)	pəkir-ək	"to arrive"	pəkit-tək	"you pl. arrived"		
	qeper	"glutton"	qapat-čəŋ-ən	"big glutton"		
	eŋer	"star"	aŋat-ɬəŋ-ən	"star"		
	kur-ək	"to buy"	kot-yo	"purchase"	kun-nin	"he bought it"

I delete the feature [sonorant] by rule (36), resulting in a [-sonorant] default, and let [-voice] be assigned as a side effect resulting from the fact that the segment is a stop, and all obstruent stops in the language are voiceless. An equivalent alternative is to delete voicing, resulting in [-voice] by default and [-sonorant] by linking.

(36) *R-strengthening*



Stricture features

Root node

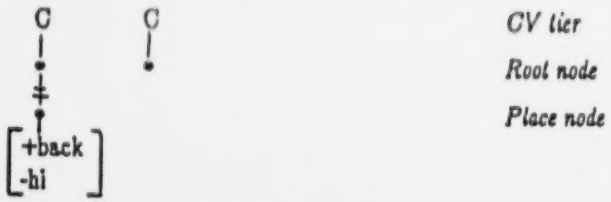
Place node

In (37) we see the effects of a rule whereby *q* becomes glottal stop before a consonant.

(37)	aqən	"fishing pole"	aʔn-ət	"fishing poles"
	qəraqaw-ək	"to call to fight"	ɣa-ʔraqaw-ɬen	"called to fight"
	wapaq	"toadstool"	wapaʔ-ɣəpə	"from toadstool"
	ŋireq	"two"	ŋeraʔ-mətɬəŋən	"seven (2+5)"

This alternation can be explained as the deletion of all place features by (38), leaving only the laryngeal and stricture features.

(38) *Glottal Formation*



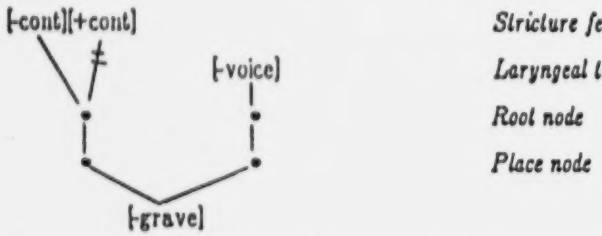
Given that a glottal stop is a voiceless stop with no place of articulation, nothing more needs to be added to derive glottal stop from *q*.

Chukchi presents additional nonassimilatory rules. One, seen in (39), simplifies the affricate *č* to *t* before voiceless nongrave consonants.

(39)				
	ətr?eč	"all"	ətr?et-teɣ-ən	"end"
	oč-ək	"to snap at"	ɣ-ot-l̥en	"snapped at"
	meč-a?qalpe	"somewhat quick"	mat-l̥əmŋəŋ	"a bit sluggish"

These alternations can be handled by deletion of the [+continuant] feature of *č* by (40).

(40) *De-affrication*

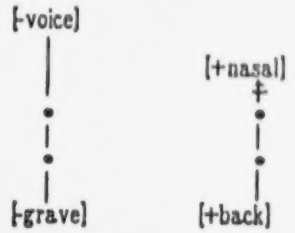


Our last rule illustrated in (41) changes *ŋ* to *ɣ* when preceded by the voiceless nongrave consonants *ɬ* and *č*.

(41)				
	ɬəŋ-ək	"to consider"	ɣe-l̥ɣə-l̥in	"considered"
	čəŋat-ək	"to split"	ɣa-čɣat-l̥ən	"split"
	ŋəɬ-et-ək	"to burn"	ŋəl̥-ɣəl̥	"smoke"
	keyŋ-ən	"from the brown bear"	čəmŋ-ə	"old raindeer buck"

While the precise phonetic and phonological motivation of this rule is not clear, the formal representation of the rule is straightforward, and it does not differ significantly from the obviously dissimilative rule *Denasalisation*; the feature [nasal] deletes after voiceless nongrave consonants by (42), and default and linking rules assign [-nasal] and [-sonorant] to the resulting segment, giving *ɣ*.

(42) *Post-Coronal Denasalisation*



In conclusion, I have provided an account of a large chunk of Chukchi phonology, under the assumption that phonological theory does not allow feature changing. Providing that similar reanalysis is possible everywhere, the formal theory of rules can be tightly constrained, and the impossibility of feature-changing accounts of assimilation is put on much firmer theoretical ground.

FOOTNOTES

1. The estimate includes vast numbers of rules in the spreading theory which spread multiple unrelated feature values. For example, a rule simultaneously assimilating labial, coronal and voicing would be included. Such rules should undoubtedly also be prohibited, for example by allowing rules to spread only a single feature or node, in the sense of Clements (1985). Such restrictions would further constrain the nonlinear theory, and would widen the gap in generative power between the linear and nonlinear theories.

2. I assume a convention applying to the output of any rule and deletes any feature or node which comes to be deprived of links to any other segment. If X is linked to segments a, b and X is delinked from b then by virtue of the link to a, X is not deleted. However, if X is not linked to a in the sequence a,b, X deletes.

3. I have modified Krause and Kenstowicz's transcriptions in two ways; Krause and Kenstowicz represent *ŋ* and *l̨* typographically as *g* and *l*, since Chukchi has no *g* or *l* phonemes. Secondly, I represent the palatal glide as *y* rather than as *j* to avoid misinterpretation as an affricate.

4. Skorik (1961) is silent on the phonetics of *kw*, which might represent a plain velar followed by *w*, or might represent a true labiovelar, with labial coarticulation throughout. The transcriptions of Bogoras (1922) represent this as *wkw*, and it is refered to as a labialised *k*. Hence a more accurate transcription of *kw* would be k^w.

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